

School and Class Environments Are Differently Linked to Future Smoking among Preadolescents¹

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Background. There are few observational studies of school and class risk factors for smoking behavior in preadolescence.

Methods. A cohort study of 2,883 children recruited in the fifth grade with follow-up in sixth grade was undertaken. Information on school and class factors was collected from principals and teachers of 91 schools.

Results. A decreased risk of smoking uptake was associated with exposure to short antitobacco education prior to the fifth grade (compared to no education). Problematic interpersonal relations in the class were associated with a relative risk of smoking initiation of 1.42 (confidence interval 1.05, 1.93) compared to positive interpersonal relations. This excess risk was not mediated by class smoking prevalence in the fifth grade. School policy and school characteristics were not significantly associated with preadolescents' smoking.

Conclusions. Class-related, rather than school-related, characteristics were associated with smoking initiation and progression. Changes in microenvironmental factors might be useful in smoking prevention among preadolescents. © 2002 American Health Foundation and Elsevier Science (USA)

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INTRODUCTION

Structural, social, and functional aspects of a given school or class may modify or even mediate the final impact of behavioral intervention or pedagogic curricula.

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Setting and contextual factors such as school size, urban/rural location, incidence of smoking, school involvement and support, and sanctions for tobacco use have in fact been proposed as important determinants of the effectiveness of a school-based intervention [1]. Few observational studies have explored the importance of school setting organizing dimensions for students' smoking behavior. In general, these studies did not present a systematic analysis of factors relevant to tobacco prevention, but rather explored sparse structural characteristics [2,3]. In addition, most studies had a cross-sectional design, thus hampering the interpretation of causal relations. The present study analysis is based on a prospective cohort of preadolescents and aimed to clarify the relative importance for early smoking of school and class structural characteristics as well as tobacco policy.

METHODS

The study population and the study design have been described previously [4]; therefore, only relevant details are reported here.

Study Cohort

The study cohort was recruited in 1997 through a weighted random sample of schools with fifth-grade students in the region, with weights proportional to the number of students. The compulsory school in Sweden consists of three 3 year blocks: junior (ages 7 through 9 years); middle (ages 10 through 12 years), and senior (ages 13 through 15 years). There are no national guidelines about duration, timing, or method for anti-tobacco education in the Swedish school system. Normally it is included in a general antidrug education concentrated in the sixth to eighth grade of compulsory school. All fifth-graders of the 91 schools that agreed to cooperate (77%) were invited to participate in the



study. Informed consent was obtained from the parents or guardians for 3,050 students (65%). Among these, 3,019 students (99%) completed the student form at baseline, and constitute the study cohort. Of the 3,019 students 1,537 were boys and 1,482 were girls. The mean age was 11.6 years (SD 0.335). The students were recruited across 213 classes in 91 schools. Ninety-five percent of the study cohort participated in the first follow-up (in the sixth grade). The present analysis is based on the 2,883 students who provided information on two occasions.

Data Collection

Information on tobacco use was collected by means of a self-completed questionnaire administered in the classroom. Tobacco use was assessed by multiple questions. First, the students were asked whether they ever had tried cigarette smoking (even one single puff). From those who answered affirmatively to this question, a complete history of cigarettes smoking was obtained, encompassing questions on the total amount of cigarettes smoked during life, age at initiation, and duration and frequency of smoking. At baseline, information about the schools and classes attended by each student was collected by means of two forms, completed by the school principal and by the class teacher, respectively. The principals were asked about the number of students and staff in the school, whether the school offered specialized curricula, the schedule of school nurses' health examinations, antitobacco policy, and disciplinary measures taken in case of students caught smoking in the school area. The antitobacco policy was assessed based on questions about the formal adoption of a local antismoking policy; the implementation of a local plan for antitobacco education; ongoing pedagogic activities against tobacco; the presence of a smoking room for the staff; and the availability of smoking-cessation programs for staff or for students. The class teacher answered questions about the number of students in the class, whether the class composition had changed from the previous year, number of hours spent on antitobacco education in the previous academic year (seven categories), teaching of other health education curricula, and a close-ended question including four statements on the interpersonal relations in the class. In addition, we used an indicator of the average social status in the school based on the proportion of individuals on social welfare in the health care district where the schools were located: the higher the index, the lower the average social status.

Data Analysis and Statistical Methods

We used two variables for outcome in this study: (a) The proportion of students in the sixth grade who had ever smoked cigarettes, among those students who had not reported any previous smoking in the fifth grade;

(b) the proportion of students in sixth grade who had progressed in their smoking habits from the fifth grade. In order to define this progression we assigned the students in both fifth and sixth grade to one of the following four groups: never smoked, smoked only a few puffs, experimented but not smoking now, and current smoking. Any move to a more advanced stage was treated as a case of progression. Almost all the potential risk factors were dichotomized (no/yes, no as the reference category). The total number of teachers and students were categorized into three and four categories, respectively, approximately corresponding to tertiles and quartiles of the overall distribution. Interpersonal relations scores were categorized either as positive (alternatives: very harmonic/quite good) or as problematic (alternatives: rather/definitive problematic). The number of hours spent on antitobacco education during the previous year was categorized as follows: less than 1 h, 1 to 2 h, more than 2 h. The social index of the area was used to group students in two categories depending on whether the indicator value was below the common median or at the median or above. In order to control for the effect of group influences, we estimated the school and class prevalence of ever smoking among participating students in the fifth grade. Both school and class prevalence was categorized into two groups, below the common median or at the median or above. We adjusted each potential risk factor for the smoking prevalence in the school or class but since this adjustment did not materially modify the risk estimates, only the analyses based on the unadjusted estimates are reported. In a multivariate analysis we included all potential risk factors which showed an association of at least borderline statistical significance in the univariate analysis. As a measure of association we estimated the relative risks and their 95% confidence intervals based on a model with a log-link and a Poisson distribution of the error. Analyses not considering the inherent hierarchical structure of the data may underestimate the imprecision of the regression estimates [5]. We therefore conducted all regression analyses by means of multilevel modeling. We used a three-level hierarchical model (students as level one, classes as level two, and schools as level three). It was therefore possible to analyze in the same model the variance introduced by both cluster levels, as the effect of clustering was expected to coincide with the level of selection. We conducted all analyses for the whole group as well as after grouping the students according to the area social index and according to whether they switched schools between fifth and sixth grade.

RESULTS

Eighteen percent of the children had ever smoked in fifth grade, while the corresponding figure in sixth

TABLE 1
School Characteristics in the Fifth Grade
among All Students ($n = 2,883$)

| Characteristics | Schools | | Students | |
|--|-----------------|------|-----------------|------|
| | No ^a | % | No ^a | % |
| Prevalence of ever smoking (%) | | | | |
| 0-17 | 47 | 51.6 | 1,582 | 54.9 |
| 18-56 | 44 | 48.4 | 1,301 | 45.1 |
| School includes grades 7 through 9 | | | | |
| No | 65 | 71.4 | 1,911 | 66.3 |
| Yes | 26 | 28.6 | 972 | 33.7 |
| Numbers of teachers | | | | |
| 6-23 | 35 | 38.9 | 726 | 25.5 |
| 25-48 | 37 | 41.1 | 1,289 | 45.3 |
| 50-100 | 18 | 20.0 | 829 | 29.2 |
| Additional special disciplines | | | | |
| No | 55 | 60.4 | 1,687 | 58.5 |
| Yes | 36 | 39.6 | 1,196 | 41.5 |
| Local antismoking policy formally adopted | | | | |
| No | 71 | 78.0 | 2,210 | 76.7 |
| Yes | 20 | 22.0 | 673 | 23.3 |
| Formal antitobacco curricula | | | | |
| No | 30 | 33.3 | 868 | 30.4 |
| Yes | 60 | 66.7 | 1,983 | 69.6 |
| Dedicated antitobacco activities (e.g., school campaigns) | | | | |
| No | 53 | 58.2 | 1,649 | 57.2 |
| Yes | 38 | 41.8 | 1,234 | 42.8 |
| Smoking cessation for personnel | | | | |
| No | 61 | 67.8 | 1,828 | 64.1 |
| Yes | 29 | 32.2 | 1,023 | 35.9 |
| Smoking room for personnel | | | | |
| No | 62 | 68.1 | 1,943 | 67.4 |
| Yes | 29 | 31.9 | 940 | 32.6 |
| Smoking cessation for students | | | | |
| No | 74 | 81.3 | 2,278 | 79.0 |
| Yes | 17 | 18.7 | 605 | 21.0 |
| Countermeasures in case of students smoking in the school area | | | | |
| Warning | | | | |
| No | 43 | 47.8 | 1,521 | 53.1 |
| Yes | 47 | 52.2 | 1,344 | 46.9 |
| Parents contacted | | | | |
| No | 7 | 7.8 | 151 | 5.3 |
| Yes | 83 | 92.2 | 2,714 | 94.7 |
| School nurse contacted | | | | |
| No | 44 | 48.9 | 1,534 | 53.5 |
| Yes | 46 | 51.1 | 1,331 | 46.5 |

^a The figures do not sum up to the total due to missing information.

grade was 33%. Between schools, the variance in smoking prevalence and smoking progression in sixth grade was small (0.030; standard error 0.057), while it was larger between classes (0.331; standard error 0.086). Table 1 reports the distribution of the study population according to school characteristics in the fifth grade. Barely one in four schools had formally established a local antismoking policy program, while two-thirds had a formal curriculum for antitobacco education. Smoking cessation programs and smoking rooms for the staff were both available in one-third of the schools. Nine-

teen percent of the schools provided smoking cessation for the students. By far, the most common countermeasure in case of students smoking in the school area was to contact the parents (92%), while direct warning and involvement of the school nurse were each reported by half of the schools. Table 2 displays the class characteristics in fifth grade. Problematic interpersonal relations were reported in only 17% of the classes. In three of five classes the teacher had taught antitobacco curricula for at least 1 h, the majority for 1 to 2 h. All the relative risks (RR) associated to school factors were close to unity with generally wide 95% confidence intervals (CI) (Table 3). Table 4 reports the associations with class characteristics. A high prevalence of ever smoking in the class was associated with an increased risk (RR = 1.34; CI = 1.05, 1.70) to take up smoking in sixth grade for previously nonsmoking students. Similarly, problematic interpersonal relations in the class were positively associated with risk of ever smoking (RR = 1.42; CI = 1.05, 1.93). Students in large classes (30 through 84 students) had a decreased risk of smoking initiation compared to students in small classes (less than 20 students). Antitobacco education of 1 to 2 h during the previous year was associated with a decreased likelihood of ever smoking compared to less than 1 h. A more intensive antitobacco education (more than 2 h) was not associated with smoking initiation. The mutual adjustment for class factors, including

TABLE 2
Class Characteristics in the Fifth Grade
among All Students ($n = 2,883$)

| Characteristics | Classes | | Students | |
|--|-----------------|------|-----------------|------|
| | No ^a | % | No ^a | % |
| Prevalence of ever smoking (%) | | | | |
| 0-16 | 108 | 50.7 | 1,452 | 50.4 |
| 17-71 | 105 | 49.3 | 1,431 | 49.6 |
| Number of students | | | | |
| 5-19 | 26 | 12.7 | 197 | 7.1 |
| 20-24 | 82 | 40.0 | 1,035 | 37.3 |
| 25-29 | 66 | 32.2 | 976 | 35.2 |
| 30-84 | 31 | 15.1 | 565 | 20.4 |
| Major changes in composition since previous year | | | | |
| No | 181 | 88.3 | 2,602 | 93.6 |
| Yes | 24 | 11.7 | 178 | 6.4 |
| Interpersonal relations | | | | |
| Positive | 166 | 82.6 | 2,294 | 83.6 |
| Problematic | 35 | 17.4 | 449 | 16.4 |
| Antitobacco education during the previous year | | | | |
| <1 h | 71 | 39.0 | 1,079 | 42.9 |
| 1-2 h | 67 | 36.8 | 899 | 35.7 |
| >2 h | 44 | 24.2 | 537 | 21.4 |
| Other health education | | | | |
| No | 51 | 26.3 | 630 | 24.1 |
| Yes | 143 | 73.7 | 1,982 | 75.9 |

^a The figures do not sum up to the total due to missing information.

TABLE 3

School Characteristics as Risk Factors for Ever Smoking in the Sixth Grade among Never Smokers in the Fifth Grade ($n = 2,351$)

| Characteristics | Prevalence (%) ^a | RR ^b | 95% CI |
|--|-----------------------------|-----------------|------------|
| Prevalence of ever smoking in fifth grade (%) | | | |
| 0-17 | 17 | 1.00 | |
| 18-56 | 19 | 1.13 | 0.88, 1.45 |
| School includes grades 7 through 9 | | | |
| No | 18 | 1.00 | |
| Yes | 18 | 1.02 | 0.78, 1.32 |
| Numbers of teachers | | | |
| 6-23 | 17 | 1.00 | |
| 25-48 | 17 | 1.05 | 0.77, 1.43 |
| 50-100 | 20 | 1.19 | 0.85, 1.66 |
| Additional special disciplines | | | |
| No | 18 | 1.00 | |
| Yes | 18 | 0.99 | 0.77, 1.27 |
| Local antismoking policy formally adopted | | | |
| No | 18 | 1.00 | |
| Yes | 19 | 1.06 | 0.80, 1.41 |
| Formal antitobacco curricula | | | |
| No | 20 | 1.00 | |
| Yes | 17 | 0.86 | 0.66, 1.11 |
| Dedicated antitobacco activities (e.g., school campaigns) | | | |
| No | 19 | 1.00 | |
| Yes | 17 | 0.90 | 0.70, 1.15 |
| Smoking cessation for personnel | | | |
| No | 17 | 1.00 | |
| Yes | 19 | 1.11 | 0.86, 1.44 |
| Smoking room for personnel | | | |
| No | 19 | 1.00 | |
| Yes | 17 | 0.87 | 0.67, 1.14 |
| Smoking cessation for students | | | |
| No | 18 | 1.00 | |
| Yes | 19 | 1.10 | 0.81, 1.50 |
| Countermeasures in case of students smoking in the school area | | | |
| Warning | | | |
| No | 19 | 1.00 | |
| Yes | 17 | 0.91 | 0.71, 1.16 |
| Parents contacted | | | |
| No | 18 | 1.00 | |
| Yes | 18 | 0.99 | 0.57, 1.73 |
| School nurse contacted | | | |
| No | 18 | 1.00 | |
| Yes | 17 | 0.93 | 0.73, 1.19 |

^a Crude observed prevalence in the sixth grade.

^b Model-based relative risks.

smoking prevalence, size, interpersonal relations, and antitobacco education did not modify the risk estimates. Similar results were obtained in the analysis of the smoking progression between fifth and sixth grade (data not shown). The associations with smoking were somewhat stronger, albeit not statistically significant, among students in areas with a median or lower socioeconomic status concerning the following characteristics: school includes grades 7 through 9 (RR: 1.38; CI:

0.93, 2.04), elevated number of teachers in the school (highest tertile vs lowest RR: 1.44; CI: 0.90, 2.30), availability of smoking cessation for students (RR: 1.38; CI: 0.92, 2.07), involvement of the school nurse in case of students smoking in school (RR: 0.73; CI: 0.50, 1.07). A separate analysis of those students who had not switched schools did not reveal different results (data not shown).

DISCUSSION

Class-related, rather than school-related, factors were relevant for smoking uptake in this large prospective study of preadolescents. Exposure to a low intensity antitobacco education prior to the fifth grade was linked to a decreased risk of smoking initiation and progression compared to absence of specific education. However, the exposure to more intensive curricula did not entail any further risk reduction. Both the reduced risk and the absence of a dose-response relation with education do not need to be interpreted causally. An elective intensive teaching on this subject in the fourth

TABLE 4

Class Characteristics as Risk Factors for Ever Smoking in the Sixth Grade among Never Smokers in the Fifth Grade ($n = 2,351$)

| Characteristics | Prevalence (%) ^a | RR ^b | 95% CI |
|--|-----------------------------|-----------------|------------|
| Prevalence of ever smoking in fifth grade (%) | | | |
| 0-16 | 16 | 1.00 | |
| 17-71 | 21 | 1.34 | 1.05, 1.70 |
| Number of students | | | |
| 5-19 | 22 | 1.00 | |
| 20-24 | 19 | 0.84 | 0.55, 1.29 |
| 25-29 | 18 | 0.80 | 0.52, 1.23 |
| 30-84 | 14 | 0.64 | 0.40, 1.04 |
| Major changes in composition since previous year | | | |
| No | 18 | 1.00 | |
| Yes | 16 | 0.87 | 0.52, 1.43 |
| Interpersonal relations in the class | | | |
| Positive | 17 | 1.00 | |
| Problematic | 24 | 1.42 | 1.05, 1.93 |
| Antitobacco curricula during the previous year | | | |
| <1 h | 19 | 1.00 | |
| 1-2 h | 14 | 0.72 | 0.54, 0.97 |
| >2 h | 22 | 1.16 | 0.85, 1.59 |
| Other health education | | | |
| No | 18 | 1.00 | |
| Yes | 18 | 1.05 | 0.78, 1.41 |
| Students smoking discussed with parents | | | |
| No | 18 | 1.00 | |
| Yes | 18 | 1.04 | 0.74, 1.48 |

^a Crude observed prevalence in the sixth grade.

^b Model-based relative risks.

grade, for instance, may be the consequence of an unusually high prevalence of smokers as during the study period there were no national guidelines for antitobacco education in schools. However, confounding by class smoking prevalence at baseline did not seem to explain these results. On the other side, we cannot rule out the possibility that the reduced risk with early and low-intensity antitobacco education might be mediated by other teacher-related characteristics (e.g., attitudes toward adult role models in school, own smoking behavior) rather than of the education itself [6]. We must, however, consider the possibility of a nonlinear relationship between amount of pedagogic exposures and targeted behavioral outcomes. Although one previous study suggested such a linearity, the program effects were seen at the level of knowledge, rather than behavioral modification [7]. In addition, recent studies could not confirm these observations in specific antitobacco programs [8]. We must therefore accept that we are still far from a complete understanding of which would be an "optimal level of youth exposure" to tobacco prevention. For instance, it is plausible that this level varies with age of the students, and that effects on preadolescents are different from those detected in late teens. Further, external factors also modify the impact of antitobacco education. Socioeconomic circumstances may be one such factor [9]. Although the corresponding evidence in our study was weak, this aspect deserves further analysis. Problematic interpersonal relations in the class predicted both the incidence of smoking initiation and the progression from less to more advanced stages of smoking between fifth and sixth grade. The explanation of this finding is by no means straightforward. The quality of the social climate was teacher-rated, and the presence of early smokers in the class might, in itself, have influenced this rating. Again, class smoking prevalence did not appear to be a confounder of the association between social relations and smoking. Previous studies have repeatedly shown that school proficiency [10], liking school [11], and perceived support from teachers and peers [12] are all linked with decreased likelihood of smoking. It is therefore plausible that perceived lack of support from the peer group and/or unfavorable pedagogic environment directly affects the smoking initiation. We could not detect any clear relation between most functional and structural characteristics of schools with potential relevance for tobacco prevention and the students' future smoking behavior. One likely explanation is that, despite the relatively wide spectrum of factors covered in this analysis, our measures of school antitobacco policy were not sensitive or specific enough. For instance, smoking ban in the school area, one of the most important antismoking policy measures, has been enforced in the Swedish schools since 1994. However, previous observational studies

also found only minimal associations between school-based structural and smoking policy variables and students' reported smoking behavior [13,14]. An explanation is that the influence on the individual behavior is much greater for proximal factors (e.g., relations in the class-group) than for distal and macroenvironmental factors (e.g., rules at the school level), especially at the young age of our study population [15]. In this study there were also some unexpected suggestions, which deserve attention in future studies. First, the rates of smoking uptake among students living in areas with lower than average social status appeared delayed in those schools where the nurse was actively and routinely involved in cases of students smoking. If this association is not an effect of chance, it is possible that this routine both reflects general disciplinary rules in such schools and effectively induces among students the perception of smoking as a disqualified and undesirable behavior [16]. It is also conceivable that young people in an unfavorable social situation are more influenced by norms delivered by adults in the school compared to socially advantaged students, who may receive multiple and/or more coherent inputs from other significant adults [17]. Second, there was a negative association of smoking with elevated numbers of students in the class, which seems to contrast with "common sense" expectations. Several explanations are possible, chance again being a plausible one. Alternatively, class size might be a mere indicator of problem behavior (small size), or of innovative and interdisciplinary education (large size). This study has two main limitations. First, the exposure definition was rather crude, and a certain degree of misclassification may have prevented the detection of weak associations. Second, the students' smoking reports were not validated. Although previous studies [18,19] have indicated that the extent of invalid reporting of smoking among adolescents is generally small, the students in this cohort were aware that they were not participating in an anonymous survey, and this may have caused some children to conceal their experimenting with cigarettes. However, the smoking prevalence at baseline was very similar to that estimated in previous cross-sectional studies in the same area [20]. On the other hand, the prospective design, the very large sample with high participation rate, both among school staff and among children, confers strength to our results. If smoking behavior during preadolescence is more sensitive to modifications in the social microenvironment than to specific antitobacco policy this is likely to represent a major cue in future antismoking programs directed to youth. The involvement of school health personnel in conveying rules and social norms on smoking, as well as quantitative aspects of early antitobacco education, should also be considered in future experimental studies.

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